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STUDIES OF THERMIONIC MATERIALS FOR SPACE POWER APPLICATIONS

Quarterly Progress Report for the Period March 1, 1966 through May 31, 1966

bу

Members of the Direct Conversion Project

Sponsored by
National Aeronautics and Space Administration
Lewis Research Center

Lewis Research Center

GENERAL ATOMIC

DIVISION OF

GENERAL DYNAMICS

JOHN JAY HOPKINS LABORATORY FOR PURE AND APPLIED SCIENCE

P.O. BOX 608 SAN DIEGO 12 CALIFORNIA

Contract NAS 3-6471

Issued: September 6, 1966

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Technical Management
NASA-Lewis Research Center
Nuclear Power Technology Branch
J. W. R. Creagh

During the period of this report, the following "reportable items" as defined by the article "Report of New Technology" evolved: None.

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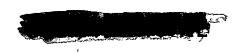
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Work done by

Members of the Direct Conversion Project

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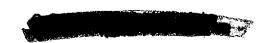
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		1.1.1. LC-7 and LC-9 Emitters
		1.1.2. LC-8 Emitter
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INTRODUCTION

This report describes the work carried out under Contract NAS 3-6471 during the period March 1, 1966 to May 31, 1966 on the following two subjects:

- 1. Fabrication of converters LC-7,-8, and -9.
- 2. Irradiation studies of thermionic materials.

Studies of other subjects of nuclear thermionic interest are being pursued under Contract NAS 3-8504 concurrently with these two studies.



I. FABRICATION OF CONVERTERS LC-7,-8, AND-9

(H. Horner, A. Weinberg)

1.1. EMITTERS

1.1.1. LC-7 and LC-9 Emitters

Emitter blanks for the unfueled LC-7 and LC-9 converters were machined, stress relieved at 1800°C for 1 hr, and outgassed at 2000°C for 50 hr using an emitter outgassing fixture set up in the Mark VI converter assembly stand. They were then assembled on molybdenum deposition mandrels and plated with 0.025 in. of vapor deposited tungsten. After outgassing at 1800°C for 1 hr and machining the deposit to a 0.010-in. thickness, the assemblies were again stress relieved at 1800°C for 1 hr. Outgassing of the LC-7 emitter assembly at 2000°C for 50 hr was initiated after the molybdenum mandrel had been etched away.

1.1.2. LC-8 Emitter

The 90UC-10ZrC fuel slabs were prepared. Machining of the first encapsulation of the emitter structure was initiated in preparation for the removal of the molybdenum fuel slab simulation pieces.

1.2. REACTIVE METAL AND OTHER COMPONENTS

Machining of the niobium collectors, cesium lead tubes, and tantalum transition piece blanks was completed. Degassing of the tantalum transition piece blanks at 1800 °C was initiated using a fixture built specially for outgassing reactive metal components.

Machining of the niobium and stainless steel collector heat sink components was completed, and the parts were prepared for the initial assembly brazing operations.

Copper cesium reservoir components were machined and prepared for degassing at 700°C.

II. PLUM BROOK IRRADIATION STUDIES

(J. Sleigh, W. Godsin)

Information from the post-test examination of the capsule-positioning-mechanism (CPM) hardware is in the process of evaluation. There was some evidence of debris in the primary system water, which could have contributed to the problems associated with both the linear ball bushings and the CPM. The galling of the CPM shaft to one end plate of the cylinder was probably caused by the combination of metal particles and similar materials rubbing on each other. The linear ball bushings may have trapped debris in the 180° turns in the races, causing scratches and subsequent binding.

A letter has been transmitted to NASA recommending rebuilding the CPM and the lower section of the V-tube. Shaft seals, chrome plating, and filters are recommended for the hydraulic cylinder, while hydrostatic bearings are recommended for the carriage, with two alternatives (Graphitar bearing and linear ball bushing). The concept of hydrostatic bearings nearly precludes the contamination of the bearing surfaces from foreign matter, since the surfaces are continuously flushed with clean water.

Investigation of the discrepancy in the calculated and observed thermal bond temperatures in the capsules has been continued. If the low thermal emissivity of a polished Inconel surface and the tolerance of the helium and argon gap sizes are taken into consideration, the calculated thermal bond temperature agrees very closely with the observed value for the fuel pod that contained the only believable high temperature thermocouple during initial capsule operation. The calculations are now being extended to establish the fuel temperature and fission power of each of the four fuel pods.

A meeting of NASA and General Atomic personnel was held at General Atomic, where the irradiation program was discussed as part of the entire NASA thermionic program. Another meeting on the same subject has been scheduled for early June at NASA Lewis Research Center.